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ABSTRACTS FROM THE ORIGINAL PAPERS.

Concentration cells and Electrolysis of Sodium ethoxide solutions.

(*Ionic activity in alcoholic solutions*)

By Masuzo Shikata.

In order to prove the reversibility of the deposition of metallic ions in non-aqueous solutions, the deposition of sodium ions of sodium ethoxide in ethylalcohol has been tested.

In dilute solutions the deposition of sodium in alcohol proceeds quiet in the same manner as in aqueous solutions, i.e. has been proved to be reversible.

Through the application of sodium amalgam electrode, which has been specially designed for this experiment, in an aqueous as well as in an alcoholic solution as a reference electrode calculation of deposition potential of sodium in alcoholic solution has been attained.

Since the activities of sodium ions of more concentrated alcoholic solutions measured by concentration cells with sodium amalgam electrodes show an enormous increase of ionic activity, a number of concetration cell measurements have been carried out.

These abnormal ionic activities have been observed in aqueous solutions in cases of highly concentrated region, but far conspicuous are in concentrated alcoholic solutions; for example 2.891 normal sodium ethoxide solution shows discrepancy 0.073 volt from the calculated value by Nernst's formula. Remarks have been given as to diffusion potentials of these solutions.

Conductivities and vapour pressures of these solutions make one convinced of that this anomaly is due to the diminution of solvation of sodium ions.

Present author thinks it more reasonable to express the ionic activity of highly concentrated solution by the special term of solvation energy *d*H (and not by the ordinary activity coefficient "*a*," including the activitiy of ions both in dilute as well as in concentrated solutions.

That is $$E=\frac{RT}{nF}\ln\frac{a_1 C_1}{a_2 C_2}+dH$$

instead of $$E=\frac{RT}{nF}\ln\frac{a_1 C_1}{a_2 C_2}$$

A New Colour Reaction of Ketonic acids, Especially Laevulinic acid.

By Kanroku Kurono, Masaichi Yamada and Shō Ishida.

Since a remarkable discovery of carboxylase was made by C. Neuberg and his coworkers, ketonic acids have occupied an important position in the research of fermentation.

In such an investigation authors have made physiological experiments about laevulinic acid, and have been urged to find suitable reactions for the acid.

Several reagents previously mentioned as characteristics for laevulinic acid, such as Legal's reagent (sodium-nitroprusside with caustic soda), Rothera's (sodium-nitroprusside with ammonia and ammonium sulphate) and Bigwood's improved reagents, and also iodoform forming reagent are all common to other ketonic acids and ketones. Orcin-hydrochloric acid reagent for laevulinic acid as one of decomposition products of thymus nucleic acid used by Levene and Mandel is not so sharp, therefore the acid is hardly to be found about to 0.1 percent.

Quantitative such as that by reduction of silver nitrate or by oxidation to acetic acid, using sulphuric acid and bichromate as oxidizing agents, are not hindered by other organic acids when they are mixed.

As already known, Seliwanoff's reagent (resorcin hydrochloric acid) for fructose gives red colour by laevulinic acid and the author found Pinoff's reagent (ammonium-molybdate with acetic acid) suitable for fructose which also gives blue coloration by the acid and these two reagents are common to pyruvic acid.

A new reaction for laevulinic acid detected by the author is of a bluish green coloration with "vanilline sulphuric acid" reagent (1 g. of vanilline in 200 gs. of conc. H_2SO_4.), which was previously used by T. Takahashi & as reagent for fusel oil.

This reaction is the most characteristic, delicate (to 0.0019 percent) and accurate for laevulinic acid, though several alcohols, esters, acids, aldehydes and ketnones also produce individual colorations. Pyruvic acid likewise gives the same but differentiating from laevulinic acid in its bluer predominant coloration, and its sharpness. The pyruvic acid which has the strength of 0.1% gives faint olive green or brown tint when coming in contact with the acid and the reagent.

As pyruvic acid and laevulinic acid are both ketonic acid, the reagent may be used as ketonic acid reagent qualitatively and also quantitatively by colorimetric method.

But this colorimetric method can not be used directly on the substances such as fermentation liquid; because sugars, lactic acid, fusel oil, esters and other ingredients prevent the reaction indicating miscellaneous colorations.

Then treat as follows:-

Evaporate the fermentation liquid in the water-bath with repeated addition of distilled water to remove alcohols, esters and other volatile substances. After cooling, residual liquid is extracted with ether four or five times after which evaporate the extract in order to expel the ether. The residue is dissolved in water and neutralized with lime water. This is again evaporated in the water-bath and the residue is crushed and extracted with absolute alcohol in the water-bath under reflux condenser for about half an hour. The calcium salt of laevulinic acid dissolves out to alcohol but calcium lactate does not. After evaporation of alcoholic extract, residue is extracted with ether several times to remove fusel oil and other substances. Here the remaining calcium laevulinate is filled up to a definite volume and is provided for quantitative test.

The reagent is the most suitable if 2 c.c. is added to 1 c.c. of sample, and the maximum coloration appears at about fifteen minutes after the addition.

Saké or "Shōyu" (Soya sauce) does not contain laevulinic acid. We found in our other experiments that Saké yeast or Shōyu yeast could easily decompose the acid.

On the Influence of Various Ratios of Sodium and Potassium upon the Growth of Animals.

By Rinjirô Sasaki.

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N. Zuntz(1) in an early study cited the comparisons of the ash of normal hays with those of hays causing disease, and proving that growth and nutrition of the farm animals were seriously affected by the alkali ratio in the ash of hay and showing, from the results of analysis, the alkali ratios of normal hays to be $Na_2O : K_2O = 1 : 3.68—4.75$, while those of injurious hays were 1 : 21.64—178.10, and stating that the injuriousness or non-injuriousness for nutrition of the farm animals was due to the alkali ratio of the ash.

M. B. Richards, W. Godden and A. D. Husband(2) in the study of metabolism of growing pigs reported that the addition of sodium chloride or citrate to the fodder, consisting of grain mixture, increased the assimilation and retention of nitrogen, calcium and phosphrus in the body, at the same time even after the fodder, with the addition of sodium salt, is fed for two weeks thereby increasing the excretion of potassium in urine and decreasing that in the feces. From the above results it seems that a close relation exists between sodium in the fodder and the metabolism of potassium.

I(3) have already shown that both sodium and potassium were indispensable for the growth of the young animal and could not be replaced, from the results of feeding experiments on white rats. And I(4) have also previously shown that when the content of sodium was insufficient in the diet, the digestibility of nitrogen became bad and that the excretion of sodium in feces became parallel to the digestibility of nitrogen and that the balance of nitrogen also became parallel to that of potassium. In this experiment the alkali ratios of the ash of diets were $Na : K = 1 : 1.54$ and 1 : 6.67. I have, therefore, continued the investigation in order to discover whether absolute quantity of the two alkali metals contained in diet or their ratio have an important influence upon the growth of young animals.

EXPERIMENTAL

The four rations used in the experiment described in this paper consisted of purified casein, potatoe starch, lard and salt mixture (sodium chloride, potassium chloride, magnesium sulphate, disodium phosphate, dipotassium phosphate, monocalcium phosphate, calcium lactate, ferrous lactate), and all the ingredients existing in sufficient quantities of which only the ratio of the alkali metals was variously changed. Besides the above nutrients, cod-liver oil and commercial oryzanin alcoholic solution were added in adequate quantity for the source of vitamin A and vitamin B.

The synthetic ration consisted of the above nutrients as casein 18, starch 70, lard 6, salt mixture 4, and cod-liver oil 2%. The contents of the alkali metals in the four synthetic rations are given in Table I.

TABLE I.

Contents of Alkali metals in Rations.

Rations	In Dry Matter.		Ratio.
	Sodium %	Potassium %	Na : K=1 :
A	0.3067	0.5884	1.918
B	0.4094	1.0255	2.505
C	0.9237	0.3465	0.375
D	0.7558	1.1454	1.515

The rations were mixed with distilled water and made into a firm, pasty mass by stirring them in the boiling water bath to prevent scattering as far as possible. The animals were experimented giving free access to distilled water and to the desired ration. The feeding cage was equipped with a false bottom with wire screen to obviate as far as possible the consumption of excrete.

In the first experiment the comparison began with eight litters of white rats weighing from 35—56 gm. each; they were divided into four groups each of them consisting of two rats. The rations used are given on Chart I illustrating the growth curves.

In the second experiment four young rats, weighing from 65—75 gm. each, were divided into two groups, one of which cotains two rats, and the influences of the ration C and D were observed.

In the third experiment, seven litters of group II, born in the first experimental period, weighing from 54—75 gm. each, were divided into three groups. The rations used are given on Chart II illustrating the growth curves.

(1) Growth.

It will be seen from Chart I that the growth of rats on Rations A and B were almost normal but rats on Rations C and B could not grow and died, after having lived for from 15—50 days from the beginning of the experiment.

In the second experiment Groups V and VI, each on Rations C and D, grew almost the same as on Rations A and B in the first experiment in Chart I, so it seems that they had already reserved enough inorganic nutrients in the body before the experiment.

In the third experiment, when young rats were placed upon the synthetic rations devoid of salt mixture for thirty days, they stopped growing but did not decrease body weight, although five days later they lost rapidly in weight and it seemed that they became deficient in inorganic nutrients to maintain health.

As seen in Chart II, rats on rations B, C and D could not recover thire growth and Groups VII and X could not gain anything and died even after having received Ration A. Group VIII, fed on ration A, gained in weight after forty days, but on ration C again decreased on the fiftieth day, and five days later on Ratian D decreased more and on ration B again gained.

From these trials it appears that Rations A and B are adequate for supporting growth, although rations C and D are not satisfactory for the very young rats less than from 35—56 gm. in weight.

In the last trial, there were a few animals that could not recovered body weight after decreasing on the ration which as entirely devoid of salt mixture for thirty days. It is doubtful whether they exhausted the alkali neutralizing acid which was produced by the decomposition of substances in the body.

To obtain the daily intake of alkali metals, residues remaining in the food cups were removed each day, dried and subtracted from the ration offered.

The results and calculations pertaining to the first, record, fifth and sixth groups of eight rats are given in Table II.

TABLE II.

Food Consumption.

Average Daily Consumption of Ration per Animal.

Group No.	Date	Ration (gr)	Dry Matter (gr)	Na (mgr)	Na per 10 gr. body wt. (mgr)	K (mgr)	K per 10 gr. body wt. (mgr)
I	May 30–June 9, 1924	23.08	7.236	22.19	2.1	42.58	4.0
II	July 14—20	22.81	7.775	31.83	2.7	79.74	6.8
V	July 17—24	24.50	10.478	95 42	8.3	35.79	3.1
VI	July 21—27	21.38	8.200	62.02	5.4	93.96	8.2

The results of the previous experiment are shown for reference in Chart III.

(2) Metabolism.

To collect feces and urine the experimental rats were confined in a large glass dish measuring 21 cm. diameter by 24 cm. depth. The rats were supported about 3 cm. above by the double wire screen. By this means, the consumption of feces was practically entirely avoided. The experimental days during which excrements were collected were seven.

The results and calculations pertaining to the first, second, fifth and sixth groups of eight rats are given in Table III and IV.

TABLE III.

Metabolism of Sodium

Group No.	Date	Ratio of alkali metals eaten Na : K = 1 :	Average daily total Sodium intake per rat (mgr.)	Average daily Sodium excreted per rat (mgr.)			Balance (mgr.)	Gain in weight (gr.)
				in feces	in urine	total		
I	May 30—Jun. 9 1924	1,918	22.19	9.89	20.12	30.01	−7.82	+14.0
II	Jul. 14—20 1924	2,505	31.83	13.10	25.23	38 33	−6.50	+ 2.5
V	Jul. 17—24 1924	0,375	95.42	14 65	79.10	93.75	+1.67	+ 6.8
VI	Jul. 21—27 1924	1,515	62.02	15.15	46.18	61.33	+0.69	+10.2

Table IV.

Metabolism of Potassium

Group No.	Date	Ratio of alkali metals eaten Na : K = 1 :	Average daily total Potassium intake per rat (mgr.)	Average daily potassium excreted per rat (mgr.)			Balance (mgr.)	Gain in weight (gr.)
				in feces	in urine	total		
I	May 30—Jun 9 1924	1.918	42.58	4.67	35.35	40.02	+2.56	+14.0
II	Jul. 14—20 1924	2.505	79.74	6.95	70.13	77.08	+2.66	+ 2.5
V	Jul. 17—21 1924	0.375	35.79	3.55	25.14	28.69	+7.10	+ 6.8
VI	Jul. 21—27 1924	1.515	93.96	5.00	85.43	90.43	+3.53	+10.2

(3) Metabolism of Nitrogen.

The contents of nitrogen in the rations used in this trial are shown in Table V. Almost all of the nitrogenous materials were furnished in the form of casein. Total nitrogen excreted in feces and urine were determined by Kjeldahl's method applying parts of samples which were collected for the determination of alkali metals. The results are shown in Table VI.

DISDUSSION

The alkali metals are absolutely necessary not only for growth of young animals but also for maintenance of health and the effect, attributed to their ratio, is more important, especially when the animals are very young.

Table V

Content of nitrogen in the ration

Ration	Total N in dry matter (%)
A	2.6741
B	2.6653
C	2.6657
D	2.6496

TABLE VI

Metabolism of nitrogen

Group No.	Date	Body weight av. (gr.)		average daily Consumption per rat		averge daily tolal nitrogen excreted per rat (mgr.)			average daily Balance of nitrogen (mgr.)	Apparent digestibility (%)
		at the start	at the and	Food (gr.)	Total nitrogen (mgr.)	in feces	in urine	Total		
I	May 30—Jun. 9 1924	97.0	111.0	23.08	193.50	25.15	103.58	128.73	+ 64.77	87.00
II	Jul. 14—20 1924	117.1	119.6	22.81	207.24	30.42	117.03	147.45	+ 59.79	85.32
V	Jul. 17—24 1924	109.6	116.4	24.50	279.30	19.04	119.51	138.55	+ 140.75	93.18
VI	Jul. 21—27 1924	108 9	119.1	21.38	217.27	22 45	111.63	134.08	+ 83.19	89.67

Both the rations A and B, studied here, permitted growth to almost the normal size. Group I on ration A, that contained 0.31% Na and 0.59% K in dry matter gained 57.0 gm. in weight per head for forty days, and Group II on ration B, that contained 0.41% Na and 1.03% K, gained 45.0 gm. but both the rations, that contained 0.92% Na and 0.35% K in the former and 0.76% Na and 1.15% K in the latter, did not maintain growth, and at last rats of Group III and IV died. The above trial began with the young rats, weighing from 35 to 56 gm. each.

When the second experiment was begun with rats weighing from 65 to 75 gm. each and the influence of the same rations on Groups III and IV was studied, each Group gained in weight 66.5 gm. and 67.8 gm. respectively per head for forty days as seen in the trial of Group V and VI in Chart I.

In this experiment it seems that the rations C and D are inadequate to the very young ones but do not show any injurious influence upon the one that grew already monerately on sufficient ration.

These results depend upon the age of the animal. During the earlier growing period the animal requires much more calcium and phosphorus than the alkali metals, with the result that an inadequate alkali ratio shows an adverse effect on the metabolism of calcium and phosphorus. The above discussion is derived from the comparison of growth in the most rapidly growing period.

The young animal, even once grown healthy on the complete ration, becomes deficient in inorganic matter after it is subjected to the ration devoid of salt. Such an animal cannot recover growth with the amount of inorganic nutrients contained in the ration C or D, although animals were fed on A or B recover growth. In such a state a loss in weight occurs as soon as ration C or D is given in place of A or B.

This fact is enough to constitute an unquestionable demonstration that the existence of adequate quantities of alkali metals in the ration is necessary for the maintenance of healthy nutrition of animal and at the same time a good ratio of alkali metals is also important. And it will be seen from the results of Groups VII, VIII and IX that rations C and D are not complete for all cases.

The extent of ratio of alkali metals in the ration used in this experiment was Na : K=1 : 0.375—2.505, which did not exercise any injurious influence upon the metabolism of nitrogen, and ration that contained a comparatively greater proportion of sodium rather increased the digestibility of nitrogen.

The retention of alkali metals in the body was raised in proportion to sodium within the limits of this experiment.

Rats excreting less amount of sodium in feces showed an inferior digestion of nitrogen. The result indicates that sodium effects more important action in the intestinal digestive juice for maintenance of alkalinity than potassium showing a good coincidence with the result of the experimental data reported previously.

The amount of nitrogen retained in the body was proportionate to that of potassium, so it is easy to indicate that these two elements are retained along with each other.

As the above results show, the absolute amount of alkali metals affects more serious influence on the nutrition of animals that have already grown moderate on the complete ration than the ratio of metals. But it appears that there is some optimum limit of alkali metals not only to the absolute quantity but also to the ratio for the very young animal.

As the experimental rations were neutral to litmus, I believe, there was no direct influence to be attributed to the reaction of ration in the animal body after digestion and absorption.

SUMMARY.

1. For maintenance of healthy nutritive condition of an animal, an adequate quantity of alkali metals and at the same time a good ratio of them in the ration is absolutely necessary for existence. Especially when the animal is very young it is seriously influenced by the alkali ratio.
2. In the extent of ratio ranging Na : K = 1 : 0.375—1 : 2.505, the ration that contained comparatively greater proportion of sodium increased much more the digestion of nitrogen than the other.
3. In the above limit the more the proportion of sodium that was contained in the ration the greater the retention of alkali metals in the body was resulted.
4. The amount of sodium excreted in feces was in proportion to the digestion of nitrogen.
5. The balance of nitrogen was proportionate to that of potassium.

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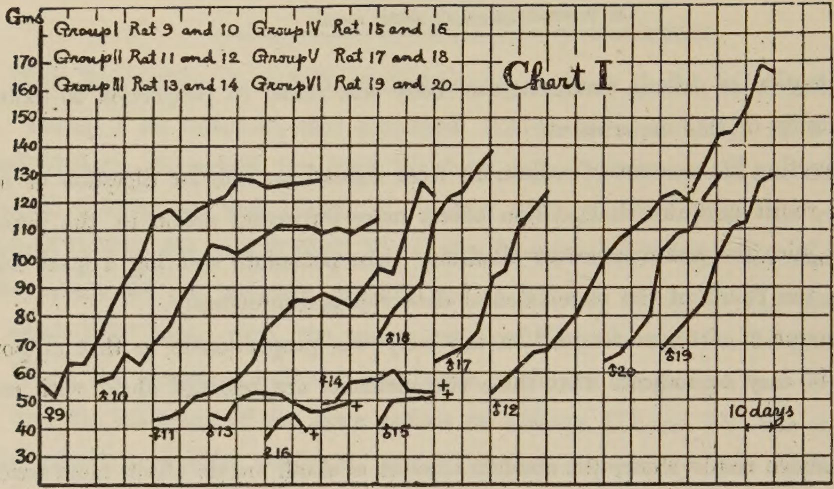
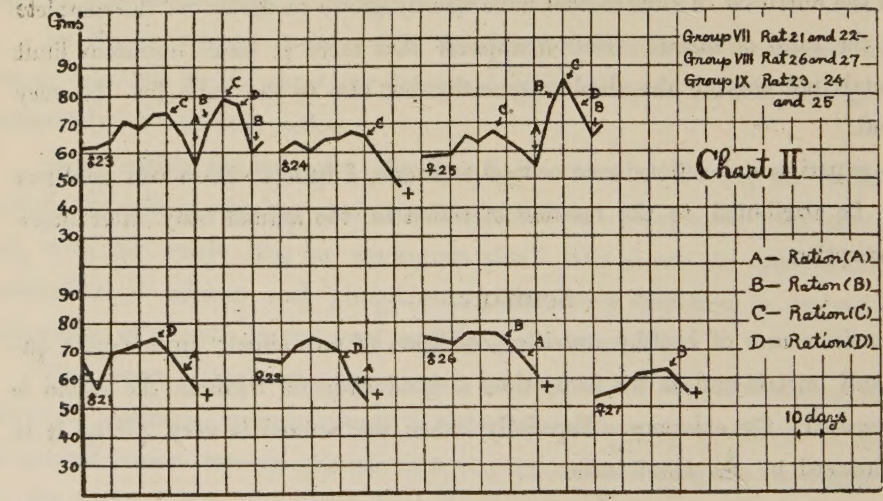
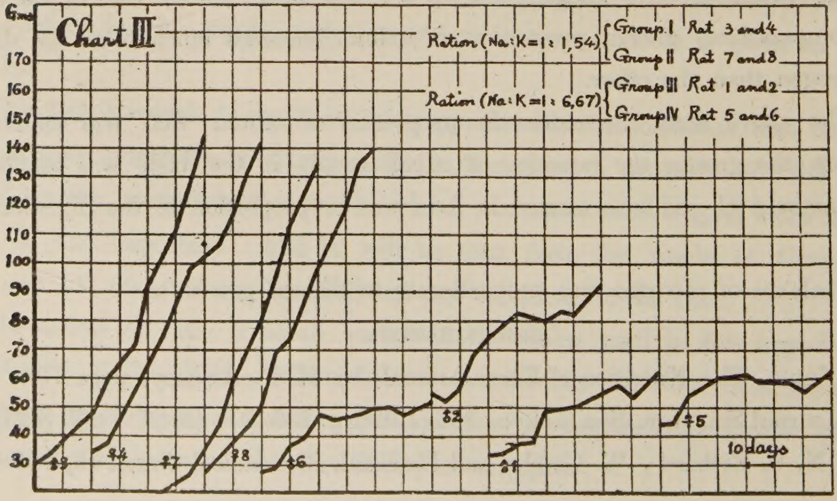

Gms
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
Group I Rat 9 and 10 Group IV Rat 15 and 16
Group II Rat 11 and 12 Group V Rat 17 and 18
Group III Rat 13 and 14 Group VI Rat 19 and 20
Chart I
♀9
♂10
♀11
♂13
♂16
♀14
♀15
♂18
♂17
♂12
♀20
♂19
+
10 days


Gms
90
80
70
60
50
40
30
Group VII Rat 21 and 22
Group VIII Rat 26 and 27
Group IX Rat 23, 24 and 25
Chart II
A— Ration (A)
B— Ration (B)
C— Ration (C)
D— Ration (D)
♂23
♂24
♀25
♂21
♀22
♂26
♀27
A
B
C
D
+
10 days


Gms
Chart III
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
Ration (Na:K = 1:1,54) Group I Rat 3 and 4
Group II Rat 7 and 8
Ration (Na:K = 1:6,67) Group III Rat 1 and 2
Group IV Rat 5 and 6
♂3
♀4
♀7
♂8
♂6
♂2
♂1
♀5
10 days